

# Computer Operations, Inc.

## APPLICATION NOTE

**SJ 71**

### Varian 620/i/f LINC Tape Mass Memory Operating System

The CO-600VP LINC Tape Mass Memory offers the Varian 620/i and 620/f user a rapid, inexpensive, reliable, removable medium, mass memory system with the following features:

102,400 16/18 bits words/reel

Dual transports standard

Expandable to 16 transports

4,200 16/18 bit words/second transfer rate

Bi-direction, high speed, direct access to any block

Read or Write any block or string of blocks without regard for adjacent blocks

Fully redundant recording for high reliability

Only 8 3/4" high and 19" wide for two transports

Controller mounts in standard expansion chassis

Complete software library for 620/i/f supplied



Computer Operations, Inc. has developed an operating system for the Varian 620/i/f computer based on the CO-600P LINC Tape mass memory system. This system provides for high speed operation of the DAS assembly system and the Fortran compiler and loader. In addition, a series of LINC utility routines are provided to simplify data transfers from user programs. A special version of AID allows keyboard control of the mass memory system for rapid manual program loading and dumping. A MARK Program records permanent clocking information on fresh tapes. A nine instruction bootstrap program is supplied for rapid computer restart.

#### DAS Assembler Operation

The Computer Operations, Inc. DAS assembler converts DAS source code to 620/i/f machine code. The source input device may be the teletype paper tape reader, high speed Remex reader, or Soroban card reader. The listing device may be the teletype or Varian line printer. The object output is stored on a LINC Tape reel. Successive jobs may be assembled in batch mode with all object output stacked on the LINC Tape. The first statement of each program is used to identify each job for subsequent selective loading. An alphabetized symbol table follows the program printout on the listing pass. Pass one of the assembler generates a symbol table; pass two lists the source code with octal addresses and instructions; pass three generates

NOTE: Portions of this system are available for the 622 series.  
Contact factory for details.

loadable object output on a LINC Tape. Passes two and three may be combined into a single pass to save time. All DAS operation and pseudo operation codes are as described in Varian manuals.

The Computer Operations, Inc. Fortran Operating System utilizes the Varian Fortran Compiler to convert the user's source program to machine code in a single pass. The relocatable object code produced by the compiler is written on a LINC Tape drive selected by the programmer. When all the source code has passed through the compiler, the LINC Fortran loader is stored in core. This loader then loads the user's object program and subroutines, all required mathematical routines, the runtime I/O package, and the runtime utility routines. All these systems routines are stored on a system library LINC Tape which also holds the compiler. Once loaded, the Fortran program is ready for execution.

#### UTILITY PROGRAMS

The LINC Tape utility routines permit the programmer to communicate with the mass storage system through subroutine calls. There are six modes included in the utility routines.

Read Blocks

Read & Check Blocks

Write Blocks

Write and Check Blocks

Check Blocks

Find Block



For each desired transfer, the programmer sets up the 620/i/f as follows:

A Register - Upper two bits of A register equals drive number - 0, 1, 2, 3. Lower 14 bits of A register equals number of blocks. (Maximum limited by core size when reading and by size of tape when writing.)

B Register - Set to initial core location of desired transfer. (Not used in Check Blocks and Find Block mode.)

X Register - Set to initial block number (tape address).

After loading the registers a JUMP and MARK is made to the appropriate routine. The Read Blocks routine stores blocks in core without regard for checksum errors. The Read and Check Blocks routine stores the desired blocks in core and performs the checksum verification for each block. If an error is detected, the routines perform a re-read an unlimited number of times. If Sense Switch 1 is on, no re-read is performed and upon returning from the LINC Read and Check routine, the A register is tested by the program. A zero indicates a checksum error. The programmer then has the option for the re-read.

The Write Blocks routine writes the desired number of blocks on tape and generates the proper checksum for each block. The Write and Check Blocks routine writes and then makes a second pass over

the blocks just written to verify the data. The checksum verification consists of reading the blocks, summing the data words as read over each block modulo  $2^{16}$ , and comparing with the previously written checksum. The summation is performed as the data words are read. Core is not disturbed during the checking process even if an error is detected. A checksum error during the check pass of Write and Check Blocks call, causes a re-write.

The Sense Switch 1 option described previously also applies to the Write and Check Blocks routine.

The Check Blocks routine verifies the data in the selected blocks. No data is read into core. An error causes a re-verify until Sense Switch 1 is turned on. The A register indicates the error condition as previously described.

The Find Block routine locates the tape five blocks below the desired block. The next call for the selected block will guarantee minimum access time (approximately 100 milliseconds). The drive number (upper two bits of A register) and X register (desired block) are the only register requirements before entry to the Find Block routine.

The LINC Tape Utility routines are resident at location X7000 in the 620/i/f. They occupy  $256_{10}$  ( $400_8$ ) locations and are located just above AID. All supplied systems routines use the utility program at X7000.

## AID PROGRAM

A special version of AID permits communication with the LINC Tape utility routines through Read and Write commands. The format is as follows:

RXXXXX,YYY,ZZZ,N.

WXXXXX,YYY,ZZZ,N.

Where: R = Read

W = Write

XXXXX = First Core Location

YYY = First Block Number

ZZZ = Number of Blocks

N = Drive Number (0, 1, 2, 3)

All numbers in Octal.

For example, to read 20 blocks ( $4096_{10}$  words) into core location 1000 from block 22 on drive 1, type:

R1000,22,20,1.

When transfer is complete, a return to AID will be made.

## BOOTSTRAP PROGRAM

A very rapid bootstrap program consists of nine locations which must be manually loaded.

|       |        |                       |
|-------|--------|-----------------------|
| X7000 | 100614 | Start Drive Zero      |
| X7001 | 101614 | Sense Data Not        |
| X7002 | X7001  | Sense Data Not        |
| X7003 | 102514 | Clear A and Input     |
| X7004 | 5344   | Decrement X register  |
| X7005 | 55000  | Store A relative to X |
| X7006 | 4477   | Delay Shift           |
| X7007 | 1000   | Jump to Sense Loop    |
| X7010 | X7001  |                       |

To initially load core, mount any marked LINC Tape on Drive 0, manually clear all registers, set the P register to X7000, and push system reset and run. The tape will start and read in a special loader which then loads in AID, the LINC utility routines, and X7400 to X7777 with the contents of block number -1. The ten negatively numbered blocks on each tape are reserved for the bootstrap process and are not normally accessible to the programmer.

#### MARK PROGRAM

The MARK Program is a special routine for MARKing fresh tapes with a clock channel, a mark channel, and block numbers. All fresh LINC Tapes must be processed once by the MARK Program before being used. This program also writes and checks a worst case test pattern on every block of a tape. The MARKing process also records the special bootstrap loader and other required programs on the tape leader.

## HARDWARE CONFIGURATION

AID, LINC Tape Utility Routines, and the MARK Program will run in a 4K Varian 620/i/f with no mainframe options.

The LINC DAS Assembler and LINC Fortran Operating System require an 8K or larger Varian 620/i/f with hardware multiply/divide and extended addressing.

The assembler and compiler are available for teletype, high speed paper tape reader, or Soroban card reader. The listing device may be the teletype or standard Varian line printer.

Special I/O packages for specific user input or output devices are also available on special quotation.

The LINC Tape controller mounts in the I/O Expansion Chassis. Three voltages, +12, +5, and -5, are required by the LINC Tape controller. The mainframe or expansion chassis power supplies furnish these voltages.

A single cable connects the controller to the dual transport assembly. An additional pair of transports may be added to the controller by means of a jumper cable between the first dual transport and the second one. If additional drives are required, special addressing logic can be easily added to the controller. A total of sixteen drives may be handled by the controller in the maximum configuration.



A special model, CO-600VA, of the controller has been developed using interrupts for block searching and a built-in DMA channel for fully automatic data transfers. A hardware accumulator in the controller performs all checksum generation and checking without 620/i/f intervention. The mainframe must be equipped with the model 620/i-12 Direct Memory Access board which is now standard on 620/i computers. The CO-600VA may be applied where simultaneous operation of the LINC Tape, computer and other I/O devices are required. The CO-600VA is software compatible with the CO-600VP when used with the standard LINC Tape Utility Routines. When used in automatic mode, the CO-600VA is controlled by a special utility routine. All register initializations are as in the programmed version.

PRICE LIST

Varian 620/i/f LINC Tape Mass Memory

CO-600VP LINC Tape Controller and Dual Transport Assembly  
including:

Transport/Controller Cable

Transport Power Cable

Two LINC Tapes with all systems programs

Five unmarked LINC Tapes

Hardware documentation manual

Software listings and instructions

Installation instructions

\$6950.00

CO-600VA As above but with automatic controller

\$7950.00

CO-602 Additional Dual Transport and Cable

\$3950.00

OEM discounts available for volume users.

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